MDNR Appendix F - Section Specific Comment 131:

Comment:

Section 4.3.4.1, Risk Assessment Method Used for Exposed RIM in this Study:

a. The formula provided for estimating risk from exposure to radionuclides is formatted for back calculating to obtain preliminary remedial goals (PRGs). Revise format to forward calculate risk, and utilize 1 picocurie per gram (pCi/g) as the soil concentration. This provides results in risk per pCi/g of soil. This approach should also be utilized in RESRAD, setting the soil concentrations to 1 pCi/g to derive risk.

b. For ingestion and inhalation rates, "iw" is for indoor worker.

c. For the ingestion rate (IR), "IRiw" should be IRAow, which is inhalation rate air, outdoor worker. IRiw, indicating inhalation rate of air, should be IRAow.

d. A table of the exposure factors must be provided.

e. Why utilize a dilution factor (DFi) for an outdoor worker and exposure to ambient air? DF is utilized for consumption of groundwater.

f. Modify the gamma shielding factor to 1.0, instead of multiplying 0.4 by 0.

Discussion:

a. The risk assessment used the PRGs found on EPA's Soil PRG Calculator web site to calculate risks from exposed soil. These are the concentrations that EPA has calculated will result in a risk of 10^{-6} to the target receptor. These can be converted to "risk" per pCi/g for that receptor by dividing 10^{-6} by the PRG (pCi/g). RESRAD was used to calculate doses from covered materials. EPA's slope factors for radon and external radiation exposure were used to create a custom slope factor library for RESRAD. RESRAD was not used to calculate risks from ingestion or inhalation of suspended particulates. The text has been revised to clarify the approach used.
b. The equations have been updated.
c. The equations have been updated.
d. A Table of exposure values is already provided as part of each individual risk assessment.
e. DF_i was included because the equation was copied as an image from EPA's web site. It was not altered.
f. EPA's default value for shielding is incorporated into the PRG calculator.

Proposed Text Change:

Section 4.3.4.1 of the revised Appendix now reads:

"4.3.4.1 Risk Assessment Method Used for Radionuclides in Exposed RIM

Radiocarcinogenic risks involving contact with surface soils were calculated using results obtained from the EPA's web-based preliminary remediation goal (PRG) calculator[1] and supporting formulas published in the associated user's guide.[2] The user's guide lists three PRG equations to calculate preliminary remediation goals for radiocarcinogens in surface soil, one for each exposure route. If incidental ingestion of surface soil is the only exposure route considered, the PRG equation is:

$$PRG_{ow\text{-}sol\text{-}ing}(pCi/g) = \frac{TR \times t_{ow}(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1-e^{-\lambda t_{ow}}\right) \times SF_s\left(\frac{risk}{pCi}\right) \times IRS_{ow}\left(\frac{100\ mg}{day}\right) \times EF_{ow}\left(\frac{225\ day}{yr}\right) \times ED_{ow}(25\ yr) \times \left(\frac{g}{1000\ mg}\right)}$$

If inhalation of suspended surface soil particles is the only exposure route considered, the PRG equation is:

$$PRG_{ow\text{-}sol\text{-}inh}(pCi/g) = \frac{TR \times t_{ow}(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1-e^{-\lambda t_{ow}}\right) \times SF_i\left(\frac{risk}{pCi}\right) \times IRA_{ow}\left(\frac{60\ m^3}{day}\right) \times EF_{ow}\left(\frac{225\ day}{yr}\right) \times ED_{ow}(25\ yr) \times \frac{1}{PEF\left(\frac{m^3}{kg}\right)} \times ET_{ow}\left(\frac{8\ hr}{day}\right) \times \left(\frac{1\ day}{24\ hr}\right) \times \left(\frac{1000\ g}{kg}\right)}$$

If direct exposure to external radiation from bare surface soil is the only exposure route considered, the PRG equation is:

$$PRG_{ow\text{-}sol\text{-}ext}(pCi/g) = \frac{TR \times t_{ow}(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1-e^{-\lambda t_{ow}}\right) \times SF_{ext\text{-}sv}\left(\frac{risk/yr}{pCi/g}\right) \times ACF \times EF_{ow}\left(\frac{225\ day}{yr}\right) \times \left(\frac{1\ yr}{365\ day}\right) \times ED_{ow}(25\ yr) \times ET_{ow}\left(\frac{8\ hr}{day}\right) \times \left(\frac{1\ day}{24\ hr}\right) \times GSF(1.0)}$$

If all three of the previously mentioned exposure routes are considered, the following equation is used to combine the results of the previous three PRG equations:

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[1] http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search

[2] http://epa-prgs.ornl.gov/radionuclides/prg_guide.shtml

$$PRG_{ow\text{-}sol\text{-}tot}\ (pCi/g) = \frac{1}{\frac{1}{PRG_{ow\text{-}sol\text{-}ing}} + \frac{1}{PRG_{ow\text{-}sol\text{-}inh}} + \frac{1}{PRG_{ow\text{-}sol\text{-}ext}}}$$

Using a target risk (TR) of 10^{-6} and the EPA web calculator's default parameters for outdoor work exposures, it can be determined that the PRG for radium-226 and its short-lived daughters in soil from all three exposure routes is 0.0248 pCi/g. Stated another way, every pCi/g of radium-226 in soil can increase the calculated risk of cancer to the hypothetical outdoor receptor by approximately 4.0×10^{-5} (10^{-6} / 0.0248, rounded to one significant figure). The EPA web calculator also provides PRGs for individual exposure routes. In this example, the PRG for the external exposure pathway is 0.0249 pCi/g, indicating exposures to direct radiation from radium and its daughters in surface soil contribute approximately 99.6% of the risk to the receptor.

In this SFS, risks to specific workers from surface soil will be evaluated using the method presented on the EPA website and illustrated above. However, assessment of carcinogenic risks to individual types of workers identified during the scheduling and manpower evaluation stages of this study may require job-specific changes in parameters such as exposure time and duration. Changes in these parameters and their justifications will be presented as part of the risk evaluation for those jobs. Because these changes to worker exposure times and durations are linear in nature, the risk result will change linearly with changes in concentrations or exposure times. For example, if the calculated risk from 45,000 hours[3] of exposure to soil containing 1 pCi/g of radium-226 is 4.0×10^{-5}, then exposure to the same soil for only one hour will be 1/45,000th of that risk or 8.9×10^{-10} per pCi/g per hour and a 1,000 hour exposure would yield a calculated risk of 8.9×10^{-7}."

EPA FEEDBACK:

EPA accepts this response and the proposed text changes.

[3] http://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search. EPA's outdoor worker receptor assumes the worker is present for 8 hours a day, 225 days/year for 25 years, or 25 years x 225 days/year x 8 hour/day = 45,000 hours of exposure.